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DEPARTMENT OF THE NAVY
NAVY EXPERIMENTAL DIVING UNIT
PANAMA CITY, FLORIDA 32407-5001

IN REPLY REFER TO:
NAVSEA TA 92-045

NAVY EXPERIMENTAL DIVING UNIT
REPORT NO. 02-92

EVALUATION OF CARLETON TECHNOLOGY INCORPORATED MOUTHPIECE UTILIZED IN LAR V UBA WITH TWO GRADES OF SOFNOLIME CO_2 ABSORBENT

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JULY 1992

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25365 92-27025 17 pgs

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NEDU REPORT No. 02-92	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZ. Navy Experimental Diving Unit 6b. OFFICE SYMBOL (If applicable) 02	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Panama City, Fl 32407-7015	7b. ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Naval Sea Systems Command 6b. OFFICE SYMBOL (If applicable) OOC	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Department of the Navy Washington, D.C. 20362-5101	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO.: PROJECT NO.: TASK NO.: 92-045 WORK UNIT ACCESSION NO.:

11. TITLE (Include Security Classification)
(U) Evaluation of Carleton Technology Incorporated Mouthpiece Utilized in LAR V UBA with Two Grades of Sofnolime CO_2 Absorbent

12. PERSONAL AUTHOR(S)
LT R.B. Giedraitis, MC, USNR and LT L.J. Crepeau, MSC, USNR

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year,Month,Day)	15. PAGE COUNT
FINAL	FROM______ TO______	JULY 1992	15

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	breathing resistance; mouthpiece; LAR V; UBA

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

One of the major contributions to the breathing resistance of underwater breathing apparatus (UBA) is the mouthpiece. Recently, Carleton Technology, Inc. supplied NEDU with a modified mouthpiece for evaluation. Reduced breathing resistance was obtained using the Carleton Technology mouthpiece in the MK 16 MOD 0 UBA.

NEDU evaluated breathing resistance of the Carleton mouthpiece and standard MK 16 UBA breathing hoses fitted to the LAR V UBA using 4-8 mesh (2.5-5.0 mm) and 8-12 mesh (1.0-2.5 mm) Sofnolime CO_2 absorbent (Molecular Products, United Kingdom), comparing it to the standard Draeger LAR V mouthpiece using 4-8 mesh Sofnolime.

(CONTINUED)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
[ ] UNCLASSIFIED/UNLIMITED [X] SAME AS RPT. [ ] DTIC USERS	Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL	22b. TELEPHONE (Include Area Code)	22c. OFFICE SYMBOL
NEDU Librarian	904-234-4351	

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete. SECURITY CLASSIFICATION OF THIS PAGE

19. (CONTINUED):

Using Sofnolime 4-8 mesh absorbent, the Carleton mouthpiece reduced overall breathing resistance in the LAR V UBA 31.5 percent, and 20.4 percent when 8-12 mesh Sofnolime was used. These findings support the future use of smaller CO_2 absorbent mesh sizes in the LAR V UBA, using the enhanced canister equipped with a modified absorbent retaining screen, in combination with the Carleton mouthpiece. This would allow longer canister durations yet simultaneously provide lower breathing resistance to the diver.

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Unannounced ☐
Justification

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Availability Codes

Dist	Avail and/or Special
A-1	

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I. INTRODUCTION

Impedance to air flow in a closed circuit underwater breathing apparatus (UBA) creates an external resistance for the diver. This is particularly evident when exercising at higher work rates and increased water depths (increased gas density). The NEDU facility conducts standardized unmanned breathing resistance testing in open and closed circuit UBAs. Testing includes the use of a breathing simulator operating at work rates comparable to different levels of exercise and simulated depths of water. Recent studies in the unmanned test facility at NEDU have concentrated on isolating the flow resistance of each component in the UBA breathing loop and its effect on overall breathing resistance. These studies indicate that one of the major contributions to UBA external breathing resistance is the mouthpiece. Reduction of flow resistance through the mouthpiece can be accomplished by increasing the cross-sectional diameter, removing protruding parts that promote turbulent flow, and improving gas flow through one-way valves. Recently, Carleton Technology, Inc. supplied NEDU with a modified mouthpiece for evaluation. Reference [1] documented reduced breathing resistance, as well as easy operation and leak tightness of the Carleton Technology mouthpiece when used in the MK 16 MOD 0 UBA. This modified mouthpiece is now being incorporated in the MK 16 MOD 0 UBA.

The current study [2] compared the breathing resistance of the LAR V UBA using the Carleton mouthpiece with the same UBA and the standard Draeger LAR V mouthpiece. The LAR V canister was packed with Sofnolime CO_2 absorbent (Molecular Products, United Kingdom), either 4-8 or 8-12 mesh (U.S. mesh), as part of an on-going evaluation of Sofnolime for Navy use.[3]

II. METHODS

Baseline breathing resistance was measured in the LAR V UBA fitted with the standard mouthpiece and breathing hoses using Sofnolime 4-8 mesh (2.5-5.0 mm) CO_2 absorbent. This absorbent is comparable in mesh size and absorption characteristics to HP Sodasorb.[4] Experimental breathing resistance was measured using the Carleton mouthpiece and standard MK 16 UBA breathing hoses fitted to the LAR V UBA using both Sofnolime 4-8 mesh and Sofnolime 8-12 mesh (1.0-2.5 mm). Sofnolime 8-12 mesh is a smaller granular size than 4-8 mesh, which enhances CO_2 absorption capability at the expense of increased breathing resistance.

Use of the apparatus for this test followed standard NEDU unmanned testing guidelines. The UBA canister was packed by a LAR V UBA qualified Special Warfare technician immediately before each test. The rig was submerged upright in 0.76 meters (2.5 feet) of fresh water maintained at 21°C (70°F) in the NEDU Test and Evaluation "Bravo" test chamber (Figure 1). The breathing circuit of the rig was attached to a breathing simulator set to provide a uniform respiratory minute volume (RMV) while breathing resistance measurements were taken.

Pressure-volume loops were obtained at depths equivalent to 4.6 and 15.2 msw (15 and 50 fsw) while the breathing simulator was operated at an RMV setting of 62.5 and 75. These settings correlate with breathing rates typically exhibited by a free-swimming diver engaged in a moderate to severe rate of work. Breathing resistance was measured at the "chrome tee" junction between the breathing simulator and the UBA using a Keller Psi differential pressure transducer (+/- 6.9 kpa) (+/-1 psi). Paired pressure-volume data were collected by a locally-written computer program employed at NEDU for unmanned breathing resistance testing.

III. RESULTS

Overall, the combination of the Carleton mouthpiece used with MK 16 breathing hoses reduced breathing resistance in the LAR V UBA 31.5% when Sofnolime 4-8 mesh absorbent was used, and 20.4% when 8-12 mesh Sofnolime was used (Figure 2). Pressure-volume loops are presented in Figures 3-6 to compare the various test configurations.

Figure 1. Common Test Chamber Floor Plan

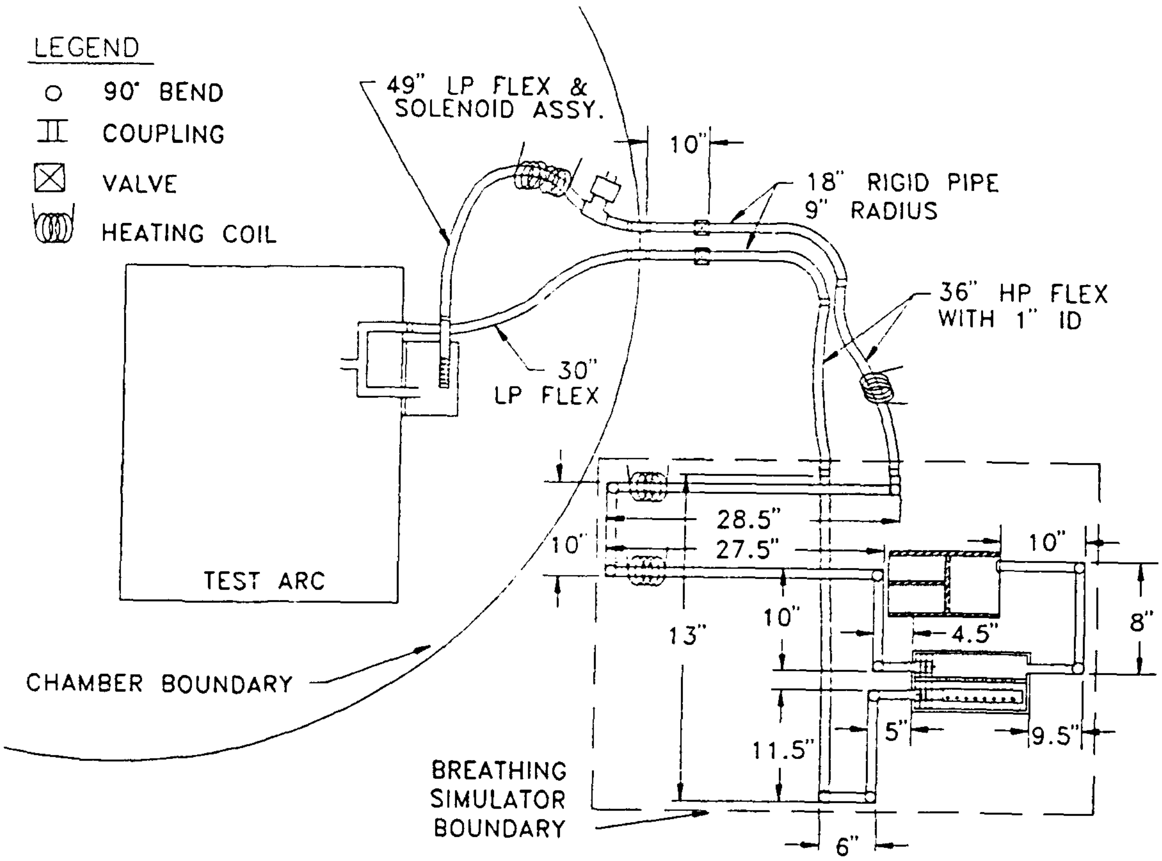


Figure 2. Work of Breathing in LAR V Using Standard LAR V Mouthpiece, Compared to the Carleton Mouthpiece Using 4-8 and 8-12 Sofnolime

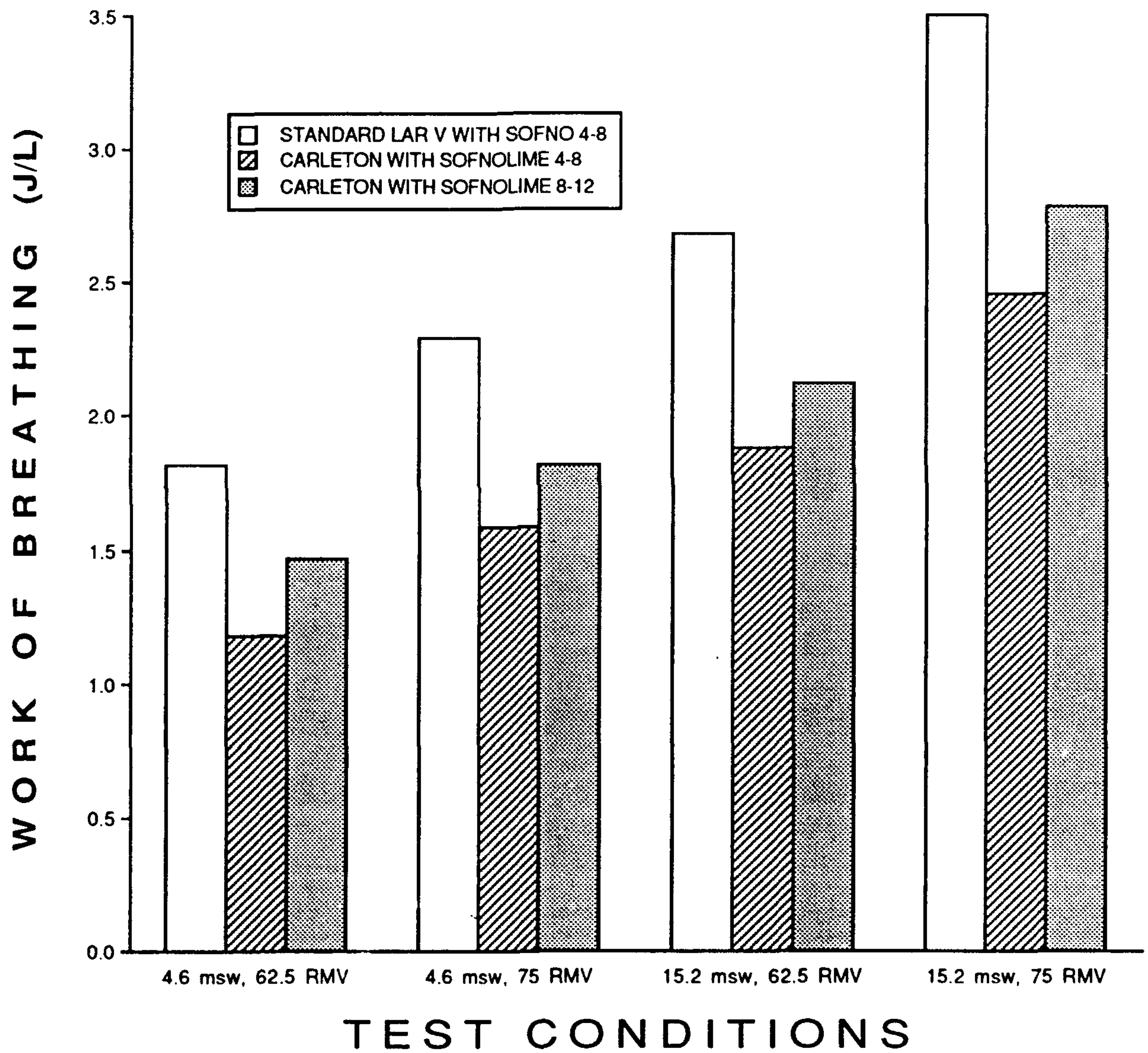


Figure 3. Breathing Loops Obtained from Standard LAR V Carleton Mouthpieces Using 4-8 Sofnolime at 62.5 RMV

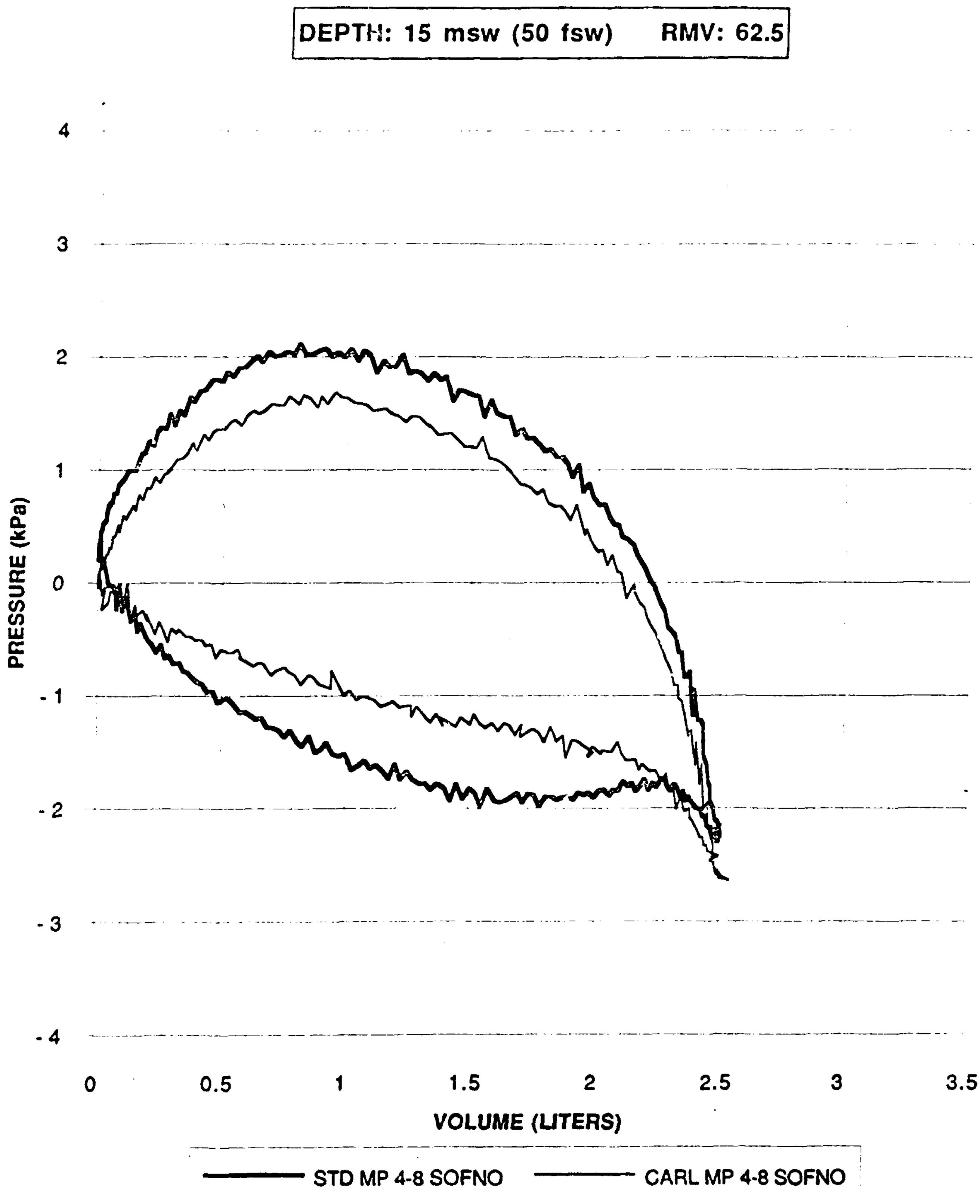


Figure 4. Breathing Loops Obtained from Standard LAR V Carleton Mouthpieces Using 4-8 Sofnolime at 75 RMV

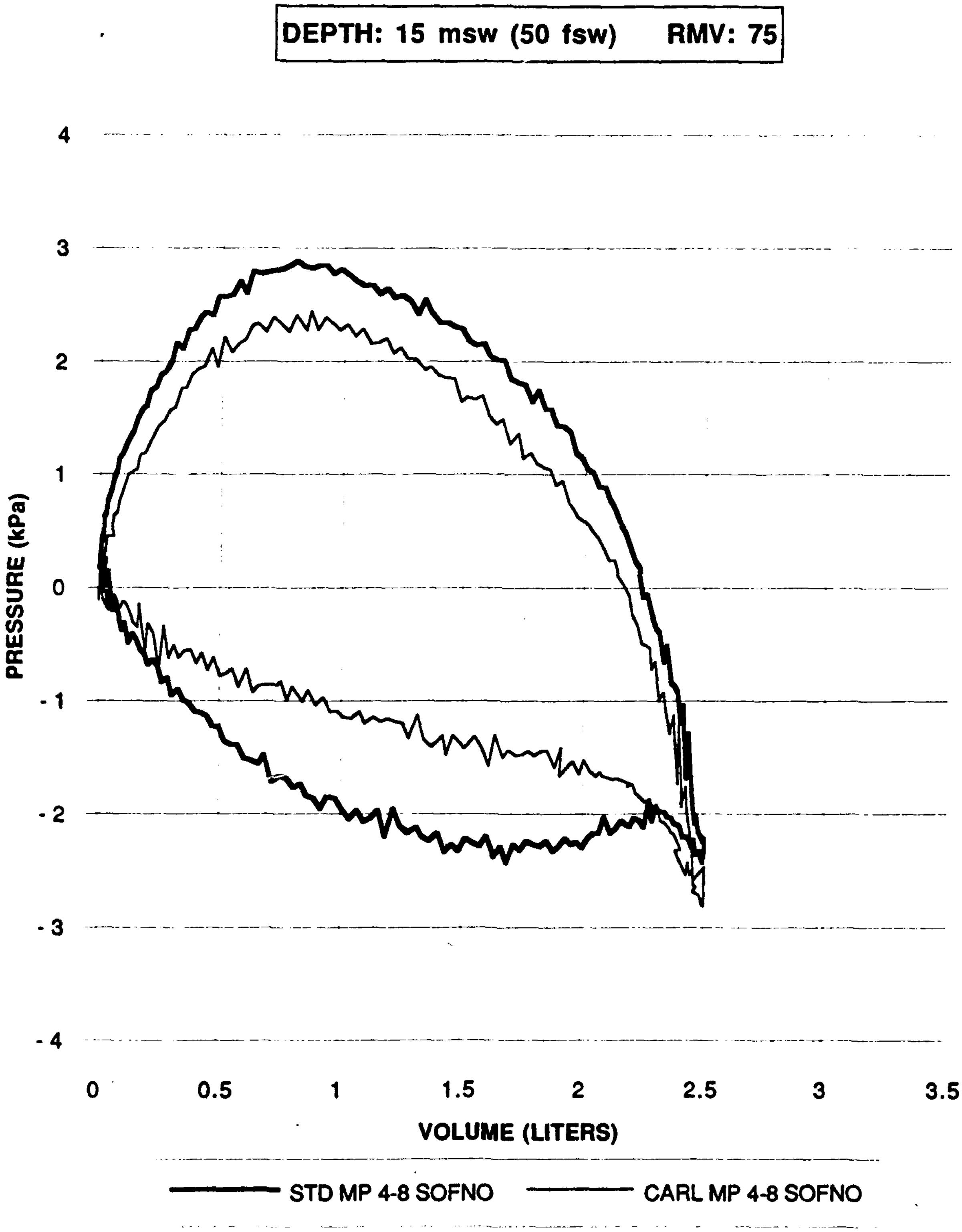


Figure 5. Breathing Loops Obtained from Standard LAR V Mouthpiece Using 4-8 Sofnolime and the Carleton Mouthpiece Using 8-12 Sofnolime at 62.5 RMV

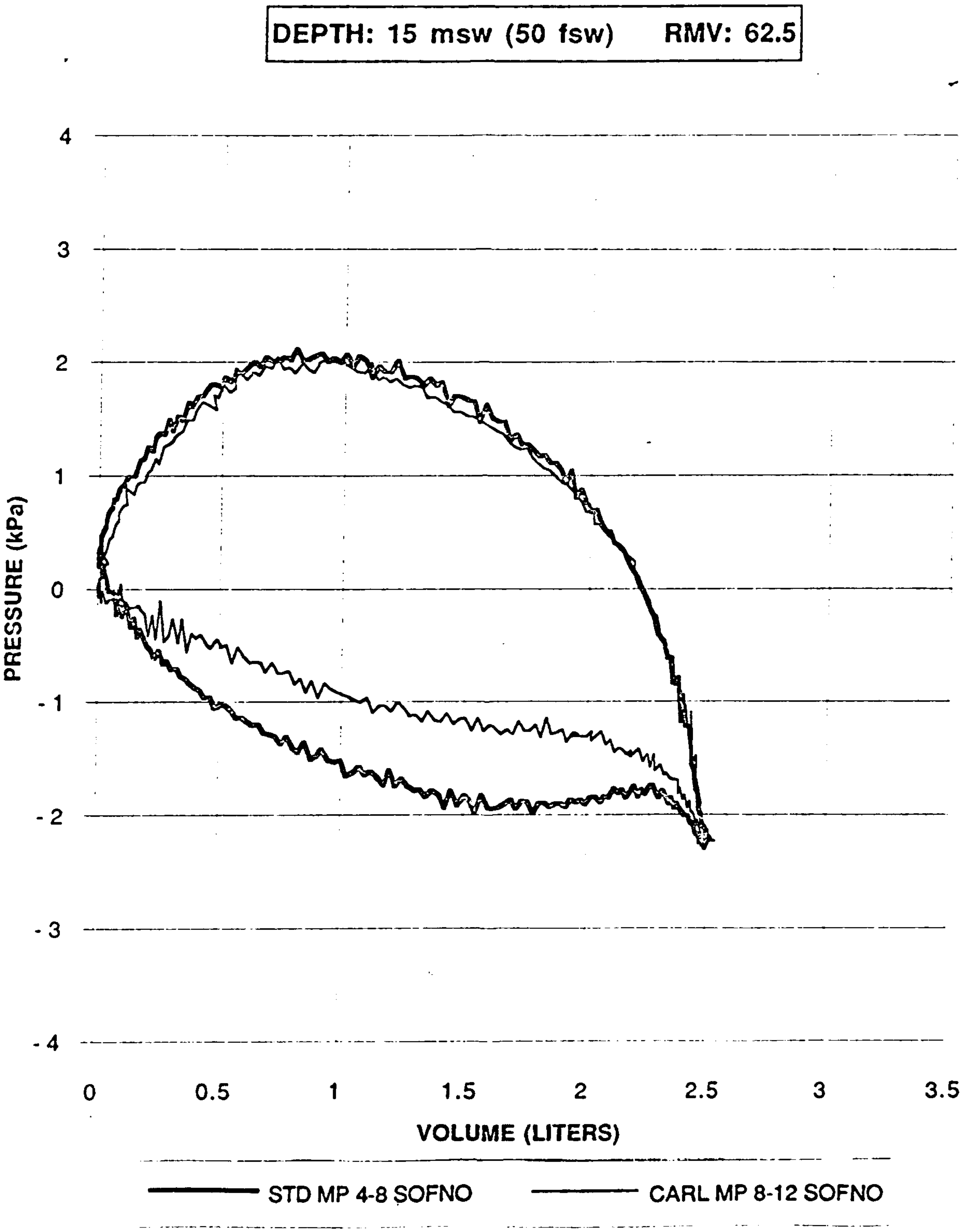
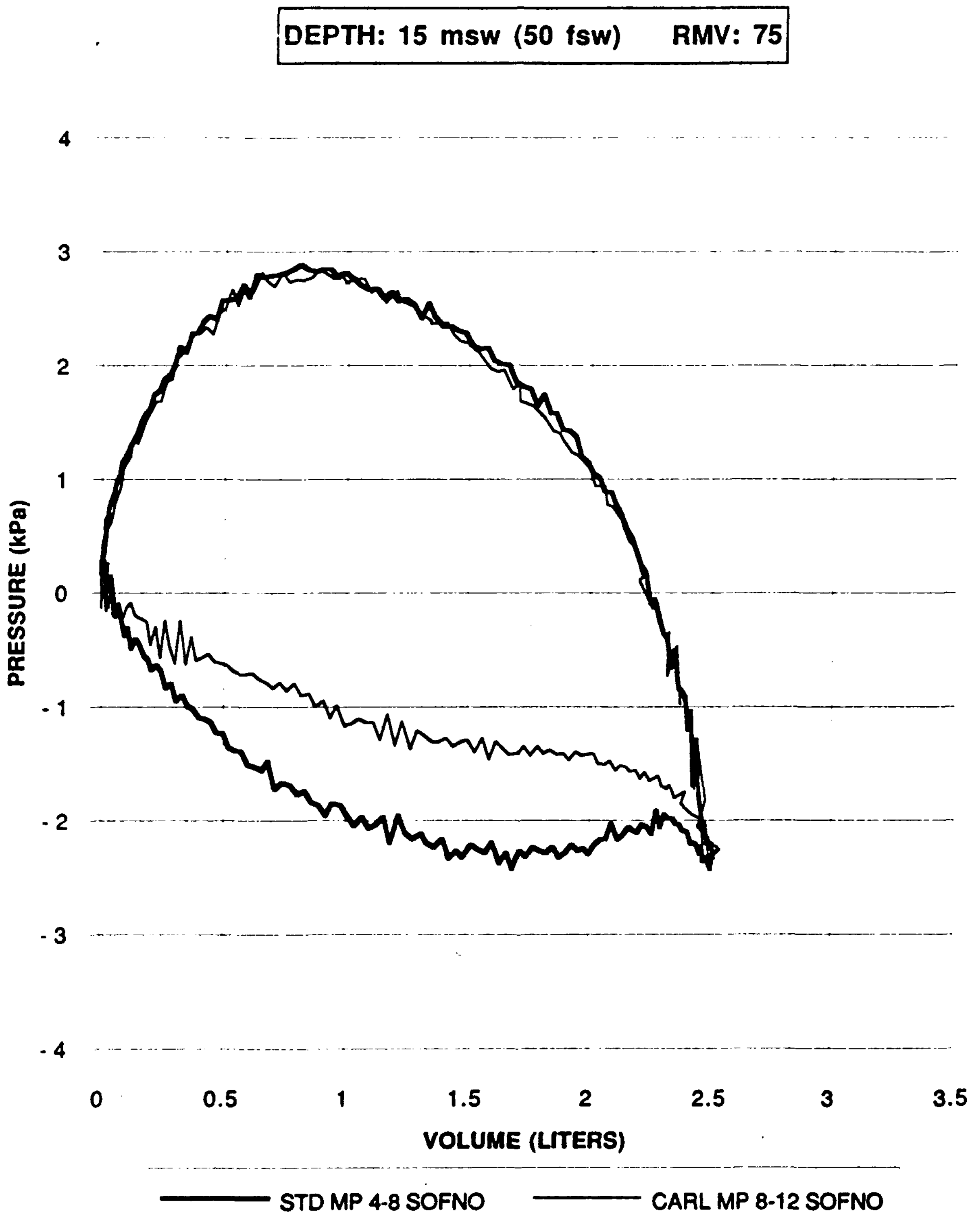


Figure 6. Breathing Loops Obtained from Standard LAR V Mouthpiece Using 4-8 Sofnolime and the Carleton Mouthpiece Using 8-12 Sofnolime at 75 RMV



IV. DISCUSSION/CONCLUSIONS

Compared to the standard LAR V, breathing resistance was substantially lower with the Carleton mouthpiece/MK 16 hose combination, even when the smaller mesh CO_2 absorbent was used. However, when the smaller grain size 8-12 Sofnolime was used, absorbent particles and dust entered the LAR V breathing loop. National Draeger, Inc. has now modified the retaining screen in the absorbent canister (part number T13255). Shake tests conducted 18 February 1992 at the Draeger facility in Germany using 8-12 Sofnolime indicate that this modification effectively retains the absorbent in the LAR V absorbent canister.

The findings from the present experiment support the future use of the Carleton mouthpiece in the LAR V. Additionally, the smaller 8-12 mesh size Sofnolime CO_2 absorbent should be tested in the enhanced LAR V UBA in combination with the Carleton mouthpiece. This would allow longer canister durations while providing lower breathing resistance to the diver compared to the standard Draeger LAR V mouthpiece using a 4-8 mesh absorbent. Substituting the Carleton mouthpiece with MK 16 Mod O UBA breathing hoses for the standard Draeger LAR V mouthpiece and hoses on the LAR V UBA should substantially improve a diver's ability to perform demanding underwater missions.

REFERENCES

1. R. B. Giedraitis, and L.J. Crepeau, *Evaluation of Carlton Technology Incorporated Mouthpiece Utilized in MK 16 Mod O UBA*, NEDU TM 92-02, Navy Experimental Diving Unit, 18 March 1992.

2. R. B. Giedraitis, *Breathing Resistance of the Carleton Mouthpiece Mounted on the Draeger LAR V (Unmanned)*, NEDU TP 92-025, Navy Experimental Diving Unit, 4 June 1992.

3. NAVSEA Task 92-045.

4. R.B. Giedraitis, *NATO Carbon Dioxide Absorbent Study*, NEDU TM 91-13, Navy Experimental Diving Unit, 1 October 1991.